10

Process
Controller

—Control Signal—→

12

Positioner

14

—pneumatic signal—→

—Position feedback—

Control Valve

16

Controller

—Measured setpoint—
—Measured position—
—Actuator pressure—

Calculated Results
- Friction
- Response Time
- Overshoot
- Spring Range
- Error, Offset

Display to user
- Alarms
- Reports
- Analysis

FIG. 1

Step Response Estimation - Wavelet Technique
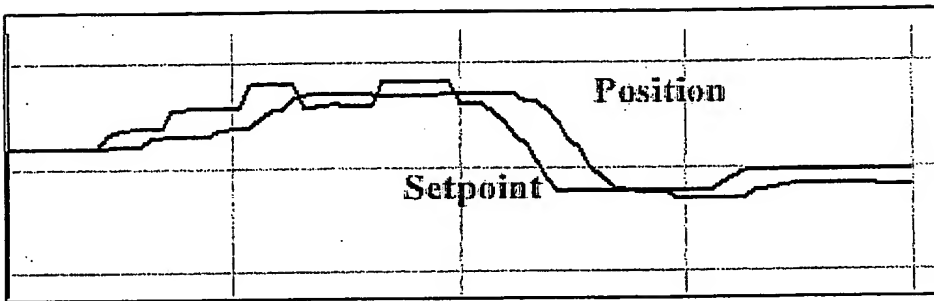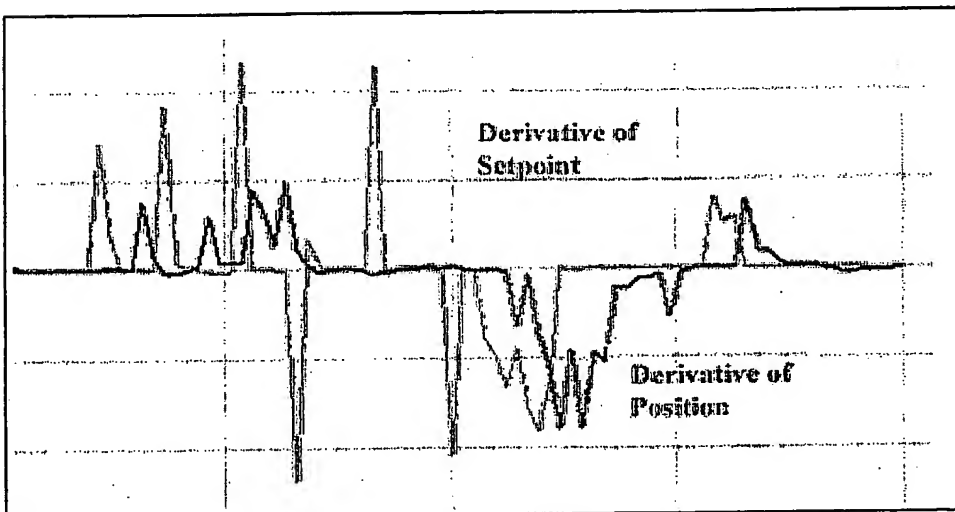

FIG. 2A

Take the derivative

FIG. 2B
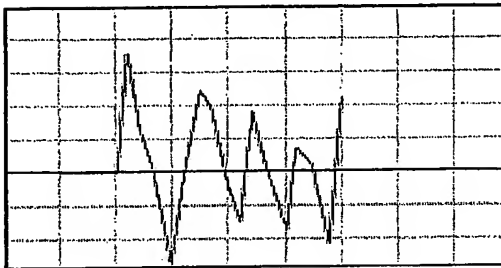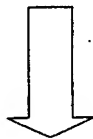
Solve the matrix for ω, the wavelet

FIG. 2C

Convolve the wavelet with a unit impulse (same as integrating)

FIG. 2D

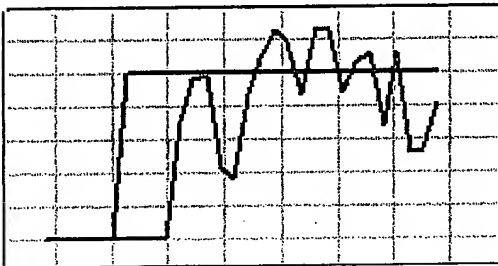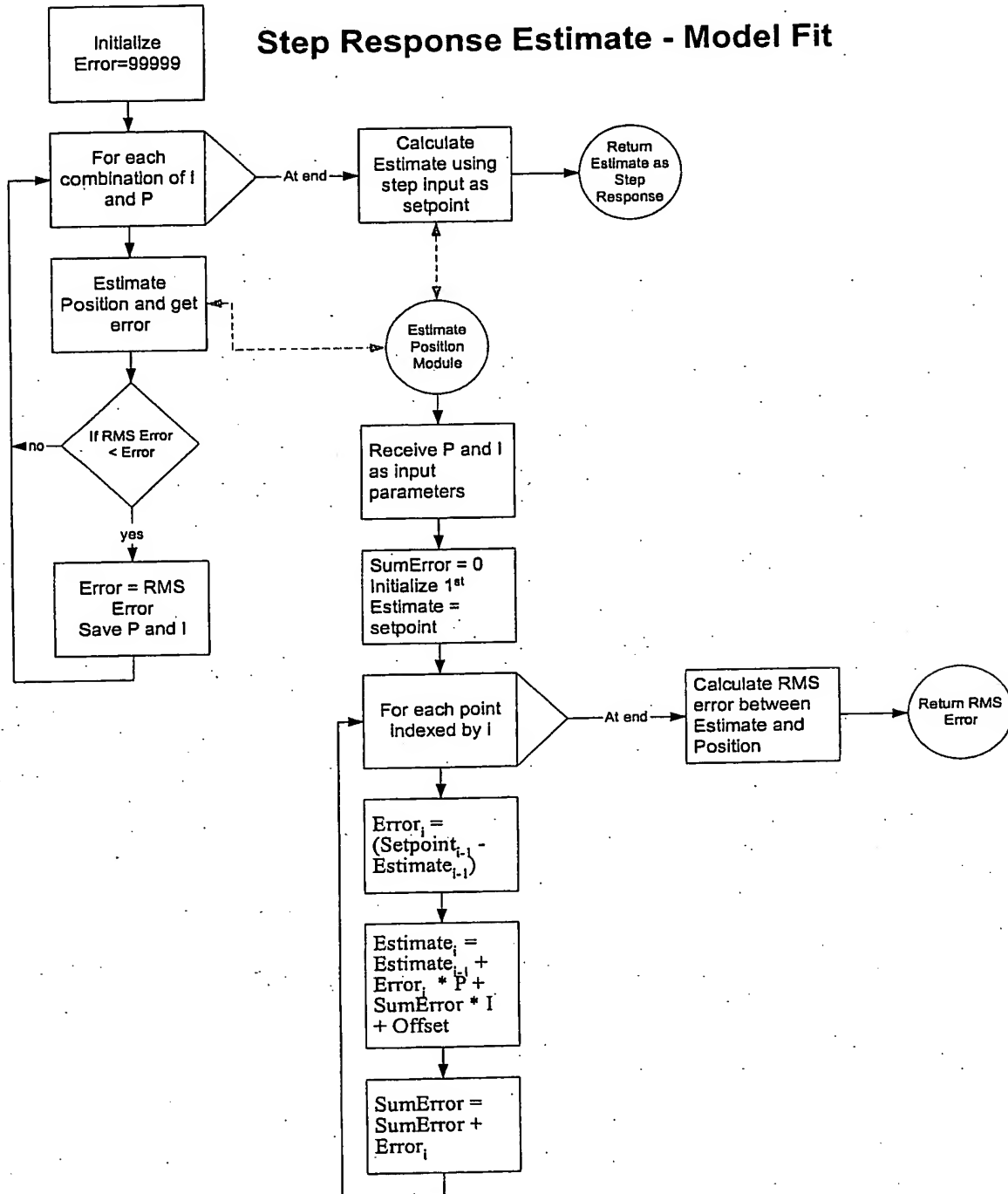Step Response Estimate

Step Response Estimate - Model Fit

Initialize Error=99999

For each combination of I and P → At end → Calculate Estimate using step input as setpoint → Return Estimate as Step Response

Estimate Position and get error

If RMS Error < Error — no / yes

Error = RMS Error Save P and I

Estimate Position Module

Receive P and I as input parameters

SumError = 0
Initialize 1st Estimate = setpoint

For each point indexed by I → At end → Calculate RMS error between Estimate and Position → Return RMS Error

$Error_i = (Setpoint_{i-1} - Estimate_{i-1})$

$Estimate_i = Estimate_{i-1} + Error_i * P + SumError * I + Offset$
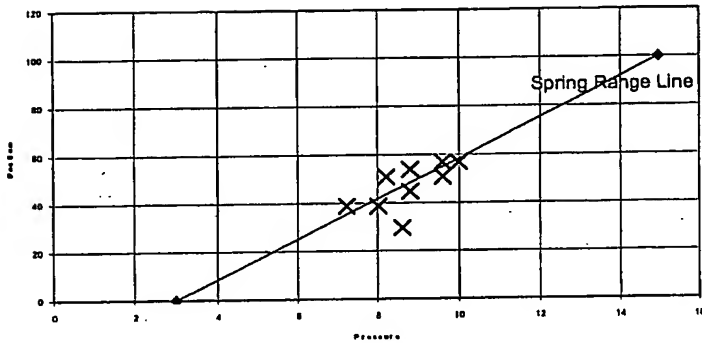
$SumError = SumError + Error_i$

FIG. 3

Pressure vs Position

FIG. 4A

Pressure vs Position

FIG. 4B

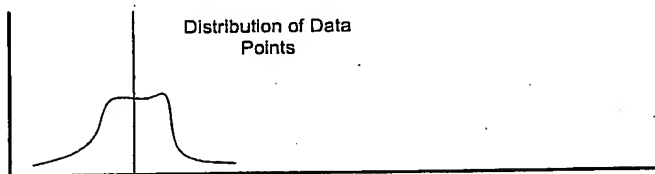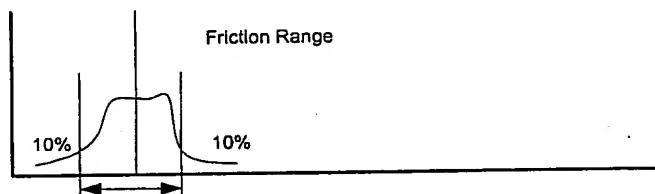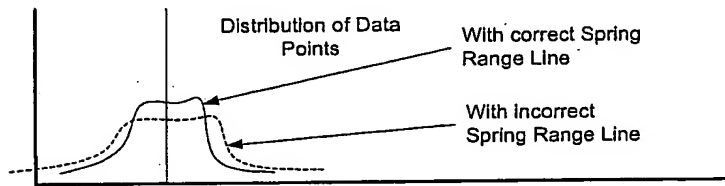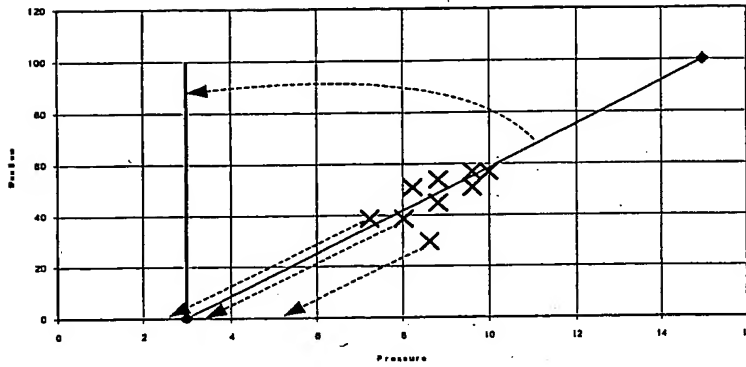Distribution of Data
Points

FIG. 4C

Friction Range

FIG. 4D

Pressure vs Position

FIG. 5A

Distribution of Data Points

With correct Spring Range Line

With incorrect Spring Range Line

FIG. 5B

Lag = 0
MinError =
99999

For each
possible lag
between 0 and
10 seconds

At End → Return Lag

Compute
SummedSquareError
(see formula in
Appendix)

Is
SumSquare
Error <
MinError

Yes →

Lag = current lag
MinError =
SumSquareError

no

Next Lag

FIG. 6